

In the claims

1. (Currently Amended) An apparatus for moving at least one of a pair of opposing surfaces in response to an electrical activation comprising:

a support including a rigid non-flexing portion, at least one pivotable arm portion integrally extending through a first hinge portion from the rigid portion, at least one opposing surface connected to the at least one pivotable arm portion for movement relative to the rigid portion, and a force transfer member integrally extending through a second hinge portion from the rigid portion and operably positioned for driving the at least one pivotable arm portion in rotational movement, the first and second hinge portions separated from one another by only a single narrow gap; and

an actuator operably engaged between the rigid portion and the force transfer member for driving the force transfer member relative to the rigid portion to pivot the at least one pivotable arm portion in response to an electrical activation of the actuator.

2. (Original) The apparatus of claim 1 wherein the support is a single piece.

3. (Original) The apparatus of claim 1 wherein the actuator is a piezoelectric device.

4. (Original) The apparatus of claim 1 wherein the rigid portion is C-shaped including a web extending between a pair of rigid arm portions.

5. (Original) The apparatus of claim 4 wherein one of the pivotable arm portions is pivotably connected to one of the rigid arm portions and the other of the pivotable arm portions is pivotably connected to the other of the rigid arm portions.

6. (Original) The apparatus of claim 1 wherein the actuator includes opposite ends and produces a spatial displacement between the opposite ends in response to an electrical activation.

7. (Original) The apparatus of claim 6 wherein the rigid portion supports a seat surface.

8. (Original) The apparatus of claim 7 wherein one of the opposite ends of the actuator is a planar surface and the seat surface supported by the rigid portion is a planar surface with the planar end surface of the actuator disposed adjacent to the planar seat surface supported by the rigid portion.

9. (Original) The apparatus of claim 8 wherein the planar end surface of the actuator applies force to the planar seat surface supported by the rigid portion in response to a spatial displacement of the actuator.

10. (Original) The apparatus of claim 9 wherein the planar end surface of the actuator operably contacts the planar seat surface supported by the rigid portion at a minimum operating spatial displacement of the actuator.

11. (Original) The apparatus of claim 9 wherein the planar end surface of the actuator operably contacts the planar seat surface supported by the rigid portion at a maximum operating spatial displacement of the actuator.

12. (Original) The apparatus of claim 9 wherein the planar end surface of the actuator operably contacts the planar seat surface supported by the rigid portion at all spatial displacements between a minimum operating spatial displacement of the actuator and a maximum operating spatial displacement of the actuator.

13. (Original) The apparatus of claim 1 wherein the force transfer member includes a seat surface.

14. (Original) The apparatus of claim 13 wherein one of the opposite ends of the actuator is a planar surface and the seat surface of the force transfer member is a planar surface with the planar end surface of the actuator disposed adjacent to the planar seat surface of the force transfer member.

15. (Original) The apparatus of claim 14 wherein the planar end surface of the actuator applies force to the planar seat surface of the force transfer member in response to a spatial displacement of the actuator.

16. (Original) The apparatus of claim 15 wherein the planar end surface of the actuator operably contacts the planar seat surface of the force transfer member at a minimum operating spatial displacement of the actuator.

17. (Original) The apparatus of claim 15 wherein the planar end surface of the actuator operably contacts the planar seat surface of the force transfer member at a maximum operating spatial displacement of the actuator.

18. (Original) The apparatus of claim 15 wherein the planar end surface of the actuator operably contacts the planar seat surface of the force transfer member at all spatial displacements between a minimum operating spatial displacement of the actuator and a maximum operating spatial displacement of the actuator.

19. (Original) The apparatus of claim 1 wherein the rigid portion, the pivotable arm portion and the force transfer member meet at one location to form a force transfer mechanism.

20. (Original) The apparatus of claim 2 further comprising an integral spring defined where at least one pivotable portion attaches to the rigid portion.

21. (Withdrawn) A method for optimizing hinge geometry comprising the steps of:

- developing preliminary geometry based on defined force and displacement requirements;
- performing two dimensional stress analysis to optimize orientation of hinge geometry;
- designing a three dimensional model of the optimized orientation of the hinge geometry;
- conducting finite element stress analysis on the three dimensional model to predict performance;
- analyzing separate curves for force versus displacement for a support and a piezoelectric actuator;
- identifying an intersection of the curves;
- determining if the intersection of the curves satisfies the predefined force and displacement requirements;
- if the intersection of the curves does not satisfy the predefined force and displacement requirements, returning to the developing step;
- if the intersection of the curves does satisfy the predefined force and displacement requirements, conducting finite element stress analysis of the three dimensional model using values corresponding to the intersection of the curves;
- determining if performance of the three dimensional model with finite element stress analysis using values corresponding to the intersection of the curves is verified against application requirements; and
- if performance is not verified, returning to the developing step.

22. (Currently Amended) An apparatus according to the method of claim 21 for moving at least one of a pair of opposing surfaces in response to an electrical activation comprising:

- a support including a rigid non-flexing portion, at least one pivotable arm portion integrally extending through a first hinge portion from the rigid portion, at least one opposing surface connected to the at least one pivotable arm portion for

movement relative to the rigid portion, and a force transfer member integrally extending through a second hinge portion from the rigid portion and operably positioned for driving the at least one pivotable arm portion in rotational movement, the first and second hinge portions separated from one another by only a single narrow gap; and

an actuator operably engaged between the rigid portion and the force transfer member for driving the force transfer member relative to the rigid portion to pivot the at least one pivotable arm portion in response to an electrical activation of the actuator.

23. (Previously Presented) The apparatus of claim 1 further comprising:

an adjustable screw connected to the rigid portion and engage able with the actuator for preloading the actuator with compressive force against the force transfer member.

24. (Currently Amended) The apparatus of claim 1 further comprising:
at least one of the first and second hinge portions extending integrally at an angle from the force transfer member to the at least one pivotable arm for pivoting the arm.

25. (Previously Presented) The apparatus of claim 1 further comprising:

a rigid non-flexing seat integrally formed on the force transfer member;
and

the actuator operably engaged between the rigid portion of the support and the rigid seat of the force transfer member for driving the rigid non-flexing seat of the force transfer member relative to the rigid portion of the support to pivot the at least one pivotable arm in response to an electrical activation of the actuator.

26. (Currently Amended) The apparatus of claim 1 further comprising:

the first and second hinge portions defining a pair of hinge portions, one hinge portion integrally extending between the force transfer member and the arm and another hinge portion integrally extending between the rigid portion of the support and the at least one pivotable arm, the pair of hinge portions extending parallel and in close proximity with respect to one another.

27. (Previously Presented) The apparatus of claim 1 further comprising:

adjustable means for preloading the actuator positioned between the rigid portion and the force transfer member, the adjustable preloading means operable for imparting a predefined compressive force on the actuator.

Please add the following new claims:

28. (New) The apparatus of claim 1 further comprising:
first and second hinge portions in close proximity to one another.

29. (New) The apparatus of claim 1 further comprising:
the support including at least one rigid non-flexing arm portion.

30. (New) The apparatus of claim 1 further comprising:
the force transfer member being rigid and non-flexing.

31. (New) An apparatus for moving at least one of a pair of opposing surfaces in response to an electrical activation comprising:

a support including a rigid non-flexing C-shaped portion having a rigid, non-flexing web portion and at least one rigid non-flexing arm portion, at least one pivotable arm portion integrally extending through a first hinge portion from the rigid C-shaped portion, at least one opposing surface connected to the at least one pivotable arm portion for movement relative to the rigid C-shaped portion, and a rigid, non-flexing, force transfer member integrally extending through a second hinge

portion from the rigid C-shaped portion and operably positioned for driving the at least one pivotable arm portion in rotational movement, the first and second hinge portions in close proximity to one another and separated from one another by only a single narrow gap; and

an actuator operably engaged between the rigid C- shaped portion and the force transfer member for driving the force transfer member relative to the rigid C-shaped portion to pivot the at least one pivotable arm portion in response to an electrical activation of the actuator.